

## EOLS-BI1612-03-CL XX Series

## EOLS-BI1612-03-LC XX Series

Single-Mode 100Mbps to 1.25Gbps FE/GBE /Fiber Channel  
 SC/LC Single-Fiber SFP Transceiver  
 RoHS6 Compliant

### Features

- ◆ Support 1.25Gbps Data Links
- ◆ A type: 1310nm FP TX /1490nm RX  
 B type: 1490nm FP TX /1310nm RX
- ◆ Up to 3km with 9/125 μm SMF
- ◆ Single 3.3V Power supply and TTL Logic Interface
- ◆ Hot-Pluggable SFP Footprint Simplex SC/LC Connector Interface
- ◆ Class 1 FDA and IEC60825-1 Laser Safety Compliant
- ◆ Operating Case Temperature  
 Standard: 0°C~+70°C  
 Industrial:-40°C~+85°C
- ◆ Compliant with SFP MSA Specification
- ◆ Compliant with Digital Diagnostic Monitor Interface  
 SFF-8472



### Applications

- ◆ Fiber Channel Links
- ◆ WDM Gigabit Ethernet Links
- ◆ Other Optical Links
- ◆ FTTX Application

### Ordering Information

Part No.	Data Rate	Wavelength	Interface	Temp.	DDMI
EOLS-BI1612-03-CL <sup>*(note1)</sup>	0.1~1.25Gbps	1310nm	SC	Standard	NO
EOLS-BI1612-03-LC <sup>*(note1)</sup>					
EOLS-BI1612-03-CLI	0.1~1.25Gbps	1310nm	SC	Industrial	NO
EOLS-BI1612-03-LCI					
EOLS-BI1612-03-CLD	0.1~1.25Gbps	1310nm	SC	Standard	YES
EOLS-BI1612-03-LCD					
EOLS-BI1612-03-CLDI	0.1~1.25Gbps	1310nm	SC	Industrial	YES
EOLS-BI1612-03-LCDI					

EOLS-BI1612-03-CLL <sup>*(note1)</sup>	0.1~1.25Gbps	1310nm	LC	Standard	NO
EOLS-BI1612-03-LCL <sup>*(note1)</sup>	0.1~1.25Gbps	1490nm	LC	Standard	NO
EOLS-BI1612-03-CLIL	0.1~1.25Gbps	1310nm	LC	Industrial	NO
EOLS-BI1612-03-LCIL	0.1~1.25Gbps	1490nm	LC	Industrial	NO
EOLS-BI1612-03-CLDL	0.1~1.25Gbps	1310nm	LC	Standard	YES
EOLS-BI1612-03-LCDL	0.1~1.25Gbps	1490nm	LC	Standard	YES
EOLS-BI1612-03-CLDIL	0.1~1.25Gbps	1310nm	LC	Industrial	YES
EOLS-BI1612-03-LCDIL	0.1~1.25Gbps	1490nm	LC	Industrial	YES

Note1: Standard version

## Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883G Method 3015.7	Class 1C (>1000 V)
Electrostatic Discharge to the enclosure	EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE	Compliant with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B	Compliant with standards Noise frequency range: 30MHz to 6GHz. Good system EMI design practice required to achieve Class B margins. System margins are dependent on customer host board and chassis design.
Immunity	EN 55024:1998+A1+A2 IEC 61000-4-3	Compliant with standards. 1KHz sine-wave, 80% AM, from 80MHz to 1GHz. No effect on transmitter/receiver performance is detectable between these limits.
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1:2007 EN (IEC) 60825-2:2004+A1	CDRH compliant and Class I laser product. TüV Certificate No. 50135086
Component Recognition	UL and CUL EN60950-1:2006	UL file E317337 TüV Certificate No. 50135086 (CB scheme )
RoHS6	2002/95/EC 4.1&4.2 2005/747/EC 5&7&13	Compliant with standards <sup>*note3</sup>

Note2: For update of the equipments and strict control of raw materials, EOPTOLINK has the ability to supply the customized products since Jan 1<sup>st</sup>, 2007, which meet the requirements of RoHS6 (Restrictions on use of certain

Hazardous Substances) of European Union.

In light of item 5 in RoHS exemption list of RoHS Directive 2002/95/EC, Item 5: Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.

In light of item 13 in RoHS exemption list of RoHS Directive 2005/747/EC, Item 13: Lead and cadmium in optical and filter glass. The three exemptions are being concerned for Eoptolink's transceivers, because Eoptolink's transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

## Product Description

The EOLS-BI1X12-X series is small form factor pluggable module for Gigabit Ethernet 1000BASE-BX and Fiber Channel single fiber applications by using 1310nm / 1490nm transmitter and 1490nm / 1310nm receiver. It is with the SFP 20-pin connector to allow hot plug capability.

The transmitter section uses a class 1 laser compliant according to International Safety Standard IEC 60825. The receiver section uses an integrated B type / A type detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

The EOLS-BI1X12-XD series are designed to be compliant with SFF-8472 Multi-source Agreement (MSA).

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	Ts	-40	+85	°C
Supply Voltage	Vcc	-0.5	3.6	V
Operating Relative Humidity		-	95	%

\*Exceeding any one of these values may destroy the device immediately.

## Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit
Operating Case Temperature	Tc	EOLS-BI1X12-X	0	+70	°C
		EOLS-BI1X12-XI	-40	+85	
Power Supply Voltage	Vcc	3.15	3.3	3.45	V
Power Supply Current	Icc			300	mA
Date Rate				1.25	Gbps

## Performance Specifications - Electrical

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
<b>Transmitter</b>						
LVPECL Inputs(Differential)	Vin	400		2000	mVpp	AC coupled inputs <sup>*(note5)</sup>
Input Impedance (Differential)	Zin	85	100	115	ohm	Rin > 100 kohm @ DC
TX_Dis	Disable	2		Vcc+0.3	V	

	Enable		0		0.8		
TX_FAULT	Fault		2		V <sub>cc</sub> +0.3	V	
	Normal		0		0.5		
<b>Receiver</b>							
LVPECL Outputs (Differential)		V <sub>out</sub>	400		2000	mV <sub>pp</sub>	AC coupled outputs <sup>*(note5)</sup>
Output Impedance (Differential)		Z <sub>out</sub>	85	100	115	ohm	
RX_LOS	LOS		2		V <sub>cc</sub> +0.3	V	
	Normal		0		0.8	V	
MOD_DEF ( 0:2 )		V <sub>oH</sub>	2.5			V	With Serial ID
		V <sub>oL</sub>	0		0.5	V	

## Optical and Electrical Characteristics

(EOLS-BI1612-03-CL, 1310nm FP and PIN, 3km)

Parameter	Symbol	Min.	Typical	Max.	Unit
9μm Core Diameter SMF	L		3		km
Data Rate			1.25		Gbps
<b>Transmitter</b>					
Center Wavelength	λ <sub>c</sub>	1270	1310	1350	nm
Spectral Width (RMS)	Δλ			4	nm
Average Output Power <sup>*(note3)</sup>	P <sub>out</sub>	-14		-8	dBm
Extinction Ratio @ 1250Mbps	ER	6			dB
Rise/Fall Time(20%~80%)	tr/tf			0.26	ns
Total Jitter	TJ			260	ps
Output Optical Eye <sup>*(note4)</sup>	Compliant with IEEE 802.3z <sup>*(note7)</sup>				
TX_Disable Assert Time	t <sub>off</sub>			10	us
P <sub>out</sub> @TX Disable Asserted	P <sub>out</sub>			-45	dBm
<b>Receiver</b>					
Center Wavelength	λ <sub>c</sub>	1450	1490	1530	nm
Receiver Sensitivity <sup>*(note6)</sup> @1250Mbps	P <sub>min</sub>			-22	dBm
Receiver Overload	P <sub>max</sub>	-3			dBm
LOS De-Assert@1250Mbps	LOSD			-23	dBm
LOS Assert	LOSA	-45			dBm
LOS Hysteresis <sup>*(note8)</sup>		0.5			dB

(EOLS-BI1612-03-LC, 1490nm FP and PIN, 3km)

Parameter	Symbol	Min.	Typical	Max.	Unit
9μm Core Diameter SMF	L		3		km
Data Rate				1250	Mbps
<b>Transmitter</b>					

Center Wavelength	$\lambda_C$	1450	1490	1530	nm
Spectral Width (RMS)	$\Delta\lambda$			4	nm
Average Output Power <sup>*(note3)</sup>	P <sub>out</sub>	-14		-8	dBm
Extinction Ratio @ 1250Mbps	ER	6			dB
Side Mode Suppression Ratio	SMSR	30			dB
Rise/Fall Time(20%~80%)	t <sub>r</sub> /t <sub>f</sub>			260	ps
Output Optical Eye <sup>*(note4)</sup>	Compliant with IEEE 802.3ah-2004 <sup>*(note7)</sup>				
TX_Disable Assert Time	t <sub>off</sub>			10	us
P <sub>out</sub> @TX Disable Asserted	P <sub>out</sub>			-45	dBm
<b>Receiver</b>					
Center Wavelength	$\lambda_C$	1260		1360	nm
Receiver Sensitivity <sup>*(note6)</sup> @1250Mbps	P <sub>min</sub>			-22	dBm
Receiver Overload	P <sub>max</sub>	-3			dBm
Return Loss		12			dB
Optical Path Penalty				1	dB
LOS De-Assert@1250Mbps	LOSD			-23	dBm
LOS De-Assert@100Mbps				-23	dBm
LOS Assert	LOSA	-45			dBm
LOS Hysteresis <sup>*(note8)</sup>		0.5			dB

Note3: Output is coupled into a 9/125 $\mu$ m single-mode fiber.

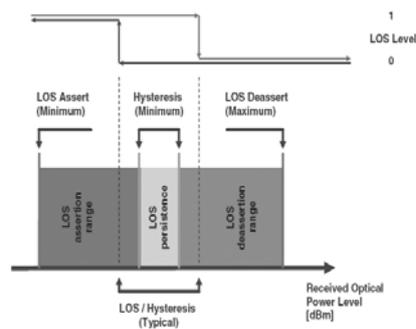
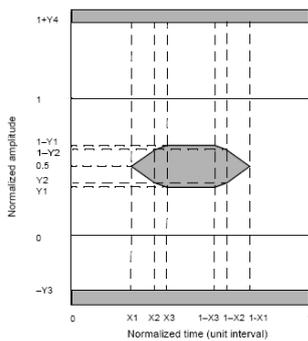
Note4: Filtered, measured with a PRBS 2<sup>7</sup>-1.

Note5: LVPECL logic, internally AC coupled.

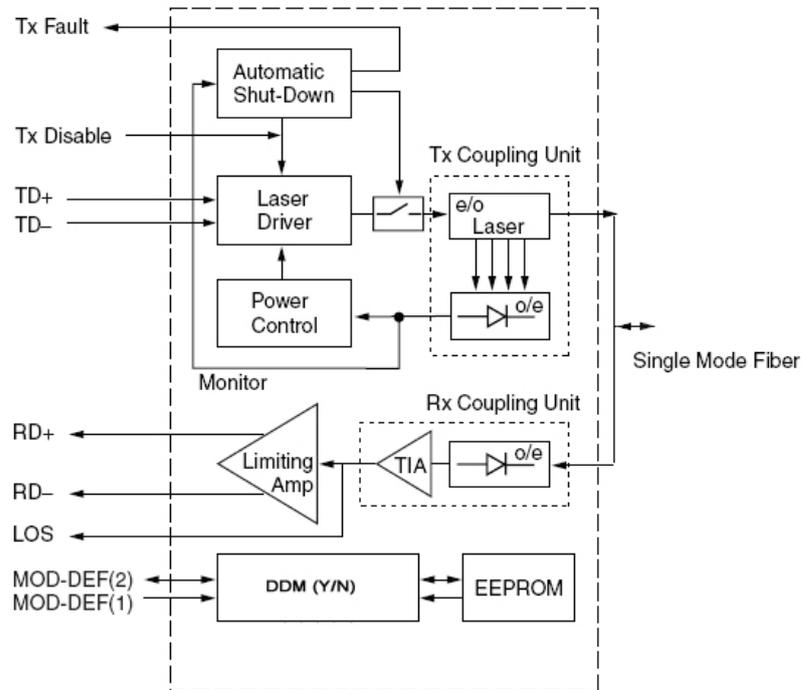
Note6: Measured at all data rates specified in Data Rate table with ER=9 dB, 2<sup>7</sup>-1 PRBS data pattern, BER <1E-12.

Note7: Eye Pattern Mask

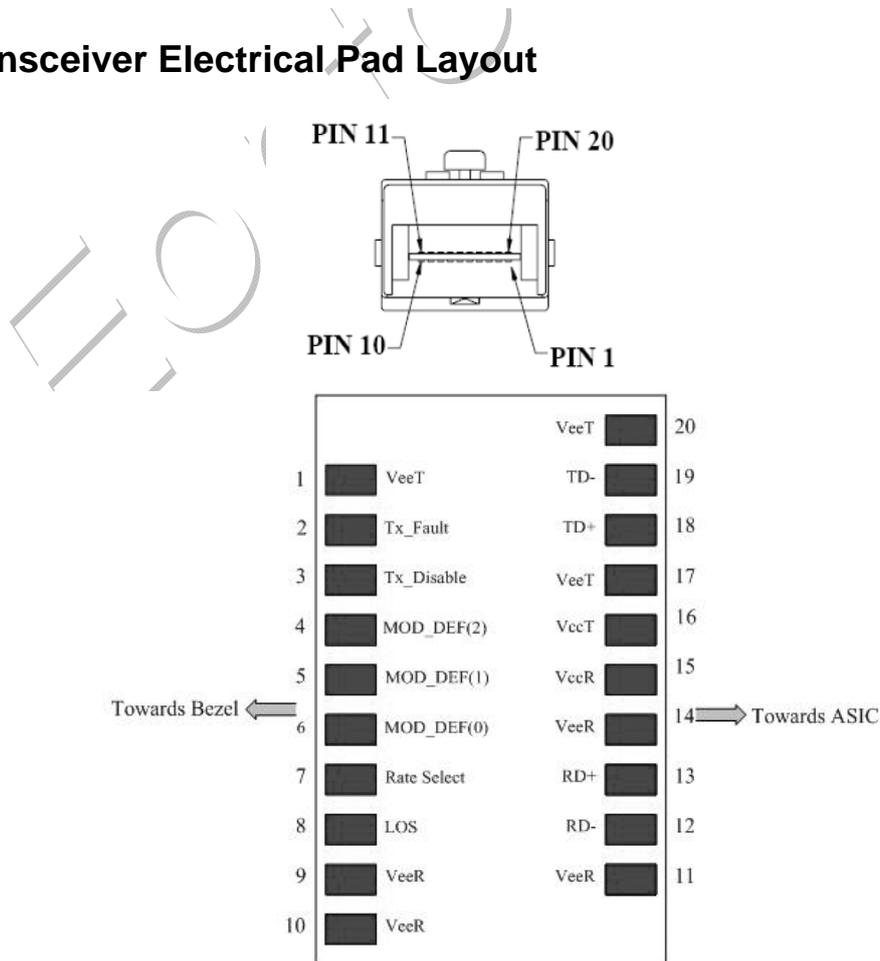
Note8: LOS Hysteresis



### Functional Description of Transceiver



### SFP Transceiver Electrical Pad Layout



## Pin Function Definitions

Pin NO.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	5)
2	TX Fault	Transmitter Fault Indication	3	1)
3	TX Disable	Transmitter Disable	3	2) Module disables on high or open
4	MOD-DEF2	Module Definition 2	3	3) Data line for Serial ID.
5	MOD-DEF1	Module Definition 1	3	3) Clock line for Serial ID.
6	MOD-DEF0	Module Definition 0	3	3) Grounded within the module.
7	Rate Select	Not Connect	3	Function not available
8	LOS	Loss of Signal	3	4)
9	VeeR	Receiver Ground	1	5)
10	VeeR	Receiver Ground	1	5)
11	VeeR	Receiver Ground	1	5)
12	RD-	Inv. Received Data Out	3	6)
13	RD+	Received Data Out	3	6)
14	VeeR	Receiver Ground	1	5)
15	VccR	Receiver Power	2	7) $3.3 \pm 5\%$
16	VccT	Transmitter Power	2	7) $3.3 \pm 5\%$
17	VeeT	Transmitter Ground	1	5)
18	TD+	Transmit Data In	3	8)
19	TD-	Inv. Transmit Data In	3	8)
20	VeeT	Transmitter Ground	1	5)

### Notes:

1) TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor on the host board. Pull up voltage between 2.0V and VccT, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

2) TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7 – 10 KΩ resistor. Its states are:

Low (0 – 0.8V): Transmitter on

(>0.8, < 2.0V): Undefined

High (2.0 – 3.465V): Transmitter Disabled

Open: Transmitter Disabled

3) Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K – 10K . resistor on the host board. The pull-up voltage shall be VccT or VccR .

Mod-Def 0 is grounded by the module to indicate that the module is present

Mod-Def 1 is the clock line of two wire serial interface for serial ID

Mod-Def 2 is the data line of two wire serial interface for serial ID

4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor. Pull up voltage between 2.0V and VccT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

5) VeeR and VeeT may be internally connected within the SFP module.

6) RD-/+ : These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

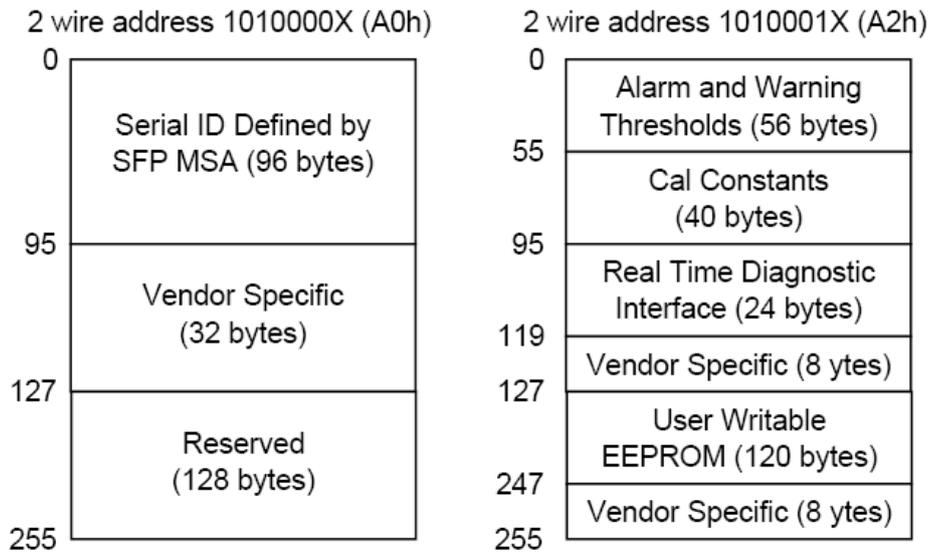
7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP connector pin. Maximum supply current is 300mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP transceiver module.

8) TD-/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

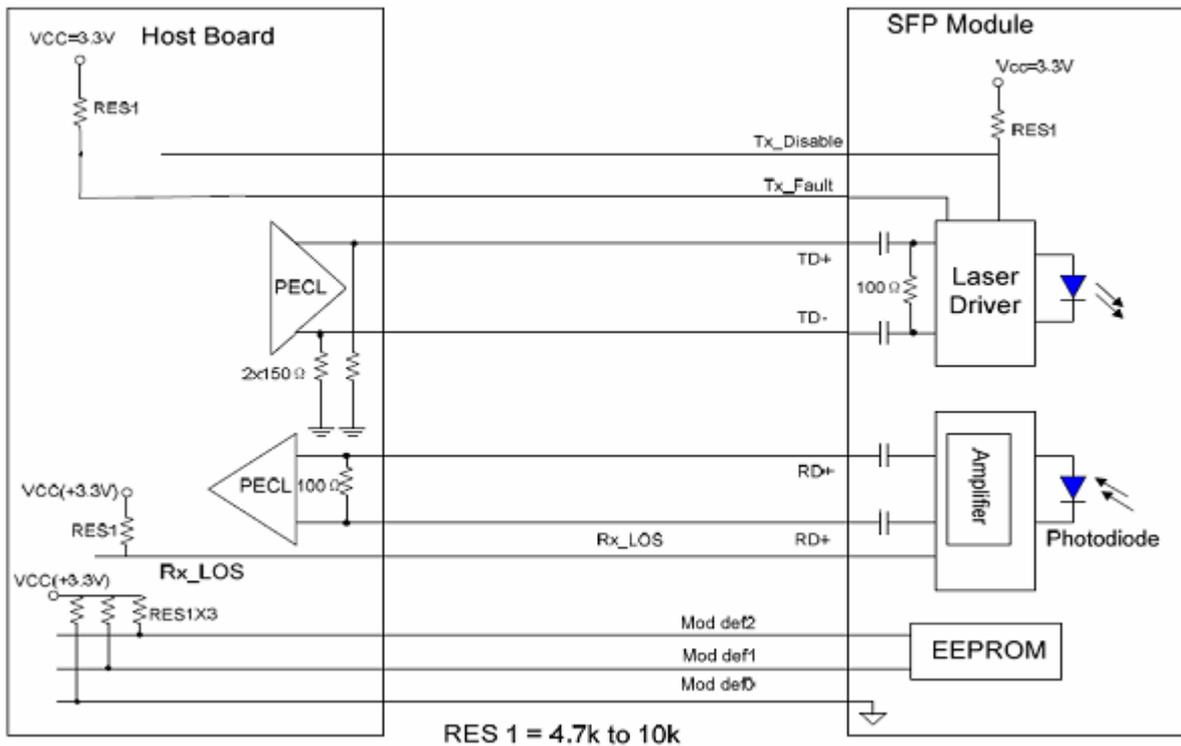
## EEPROM

The serial interface uses the 2-wire serial CMOS EEPROM protocol defined for the ATMEL AT24C02/04 family of components. When the serial protocol is activated, the host generates the serial clock signal (SCL). The positive edge clocks data into those segments of the EEPROM that are not write protected within the SFP transceiver. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

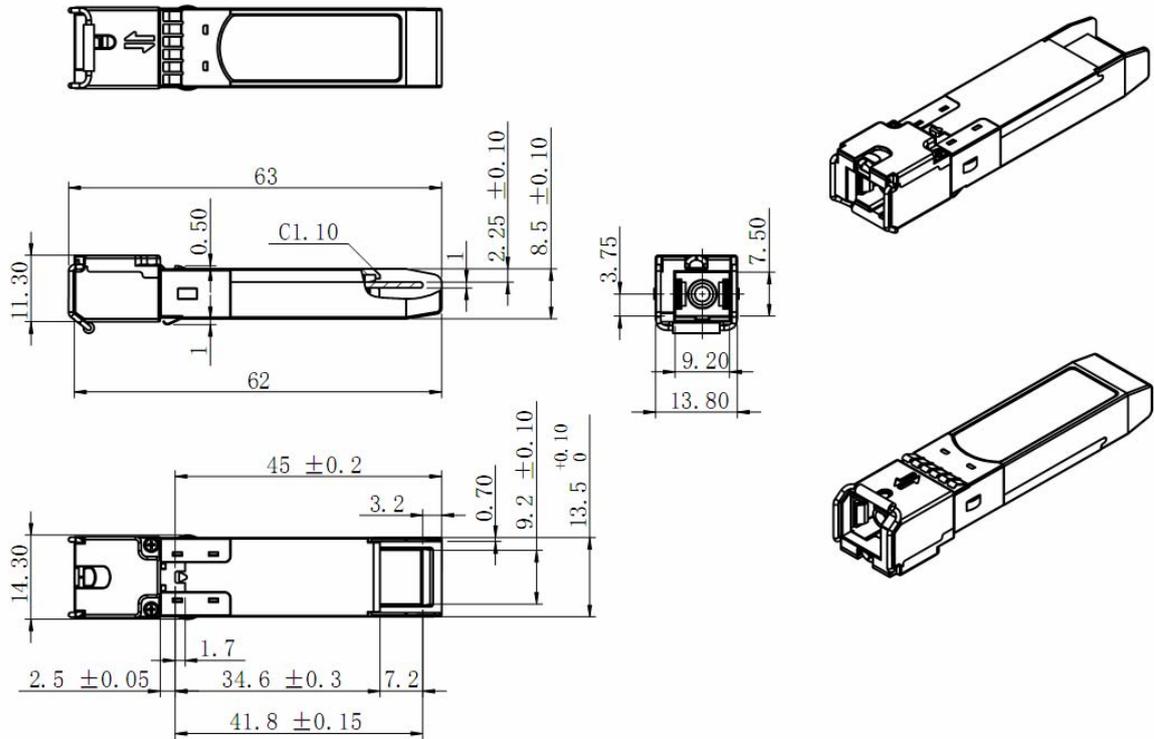
The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. If the module is defined as external calibrated, the diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56 – 95 at wire serial bus address A2H. The digital diagnostic memory map specific data field define as following .For detail EEPROM information, please refer to the related document of SFF 8472 Rev 9.3.



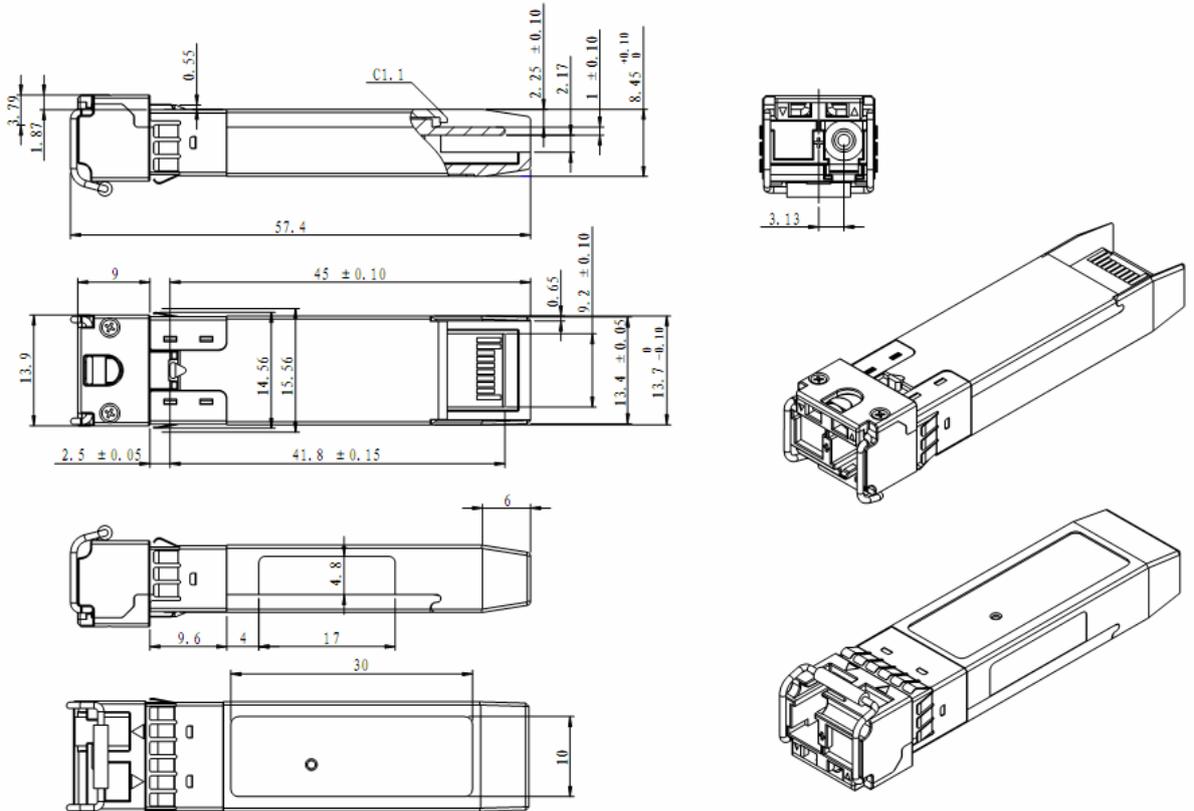
Recommended Circuit Schematic



Mechanical Specifications

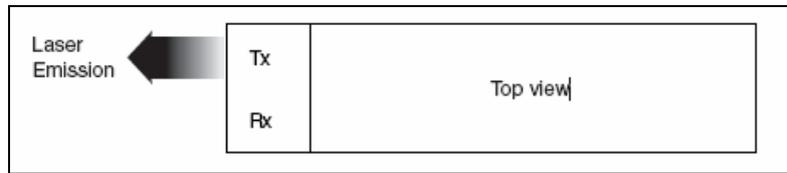


SC



LC

## Laser Emission



## Obtaining Document

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Or contact Eoptolink Technology Inc., Ltd. listed at the end of the documentation to get the latest document.

## Revision History

Revision	Initiated	Reviewed	Approved	Revision History	Release Date
V1.a	Arvin	Lyn,Jason,Walt,Nygai		Released.	Jun 13, 2013

## Notice:

Eoptolink reserves the right to make changes to or discontinue any optical link product or service identified in this publication, without notice, in order to improve design and/or performance. Applications that are described herein for any of the optical link products are for illustrative purposes only. Eoptolink makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.

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